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ABSTRACT

After taking a brief look at the developments and some generalized trends of the past three decades, this paper attempts to identify some of the characteristics of the decade ahead and new and emerging middle manpower occupations in the 1970's. It is the thesis of this paper that a country interested in rapid economic development should invest heavily in education for middle manpower development, in the education and training programs that will produce the technicians, the semiprofessional and paraprofessional workers, and the highly skilled workers who can move a nation ahead across a broad front of development. Future trends discussed include those in (1) natural resources, ecology, and environment; (2) population and urbanization; (3) transportation, communication, and information technology; (4) health and medical science; (5) science and engineering based industry; (6) government and the service sector of the economy; and (7) business and distribution. Manpower demands are discussed for the following areas: (1) agriculture and natural resources development; (2) business trade and distribution; (3) health and human service; (4) industry and manufacturing; and (5) science, engineering and technology. (AF)

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HIGHER EDUCATION AND MIDDLE MANPOWER FOR THE 1970's

I. INTRODUCTION AND A LOOK BACKWARD

Past is not always prologue, but futurists like to associate themselves with historians. Economists extrapolate future trends from past data, and meteorologists study old weather records, along with air mass analysis. Most of us would agree with Sir Isaac Newton, the great physicist and natural philosopher of the seventeenth century, that if we are to achieve a clearer view ahead of the mysteries of science and of the problems of man, we must "stand on the shoulders of the giants" who came before us.

It is fitting therefore that we take a brief look at the developments of the past three decades before attempting to identify "new and emerging" middle manpower occupations for the 1970's. Although there are, of course, significant developmental differences from nation to nation (and indeed among provinces and states within nations) it is possible to cite certain trends or generalizations that have some commonality around the world. Let me suggest a few of these trends for consideration, as a sort of backdrop for the thesis of this paper.

Some Generalized Trends of the Past Three Decades

1. An increased attention to science, engineering, and technology--pronounced in "advanced" industrial nations, but evident also in underdeveloped nations.
2. Serious and continuing concern for international understanding and cross-cultural communication.

3. A revival of nationalism, in spite of the work of the United Nations, UNESCO, and other agencies dedicated to greater cooperation among nations.
4. A systems analysis approach to economic development in many nations.
5. A deep concern in most countries of the world for greater freedom and for government which is sensitive to the needs and aspirations of the people.
6. A veritable revolution in transportation, communication, and information dissemination.
7. A concern in many areas of the world about ecological balance, environmental problems, and the conservation of natural resources.
8. World-wide attention to health and medical problems on an unprecedented scale.
9. A confrontation in many places with the grave consequences of uncontrolled population growth and of rapid urbanization.
10. Attempts at regional economic cooperation which, although they have not been highly successful, may nevertheless set a pattern for the future.
11. The development of science-based agriculture so that production of food and fiber has exceeded the most optimistic estimates of the 1950's.
12. And finally, a world-wide realization that the promise of the future is closely tied to education and the continuing development of human resources. There is a growing realization that education as human resource development, cannot be dedicated merely to the advanced university training of an intellectual elite; nor to crash efforts to attain 100 percent literacy. On the contrary, there is an increasing body of evidence to indicate that without broad-based education at secondary and collegiate levels of a vast <u>middle group</u> of youth, the economic machine will never shift into high gear.

It will be the thesis of this paper that a country interested in rapid economic development should invest heavily in education for "middle manpower development;" in the education and training programs which will produce the technicians, the semi-professional and paraprofessional workers, and the highly skilled workers who can move a nation ahead across a broad front of development - - in agriculture, business, health, industry, and human services.

Let us turn now to a brief view down the road to 1980. What are some probable characteristics of the decade ahead?

II. THE ROAD TO 1980

Peering into the future is a tenuous business, and no one's crystal ball is very clear. However, within a set of assumptions or "boundary conditions" about society, I will be brash enough to unveil some personal predictions of the world scene for 1980. If one or more of the assumptions proves to be unfounded, the road to 1980 becomes tortuous indeed. First, the assumptions:

1. A major world conflict can be avoided.
2. Democratic societies and individual freedom will maintain a strong balance of power against authoritarian dictatorships of both the left and the right.
3. Interracial animosities throughout the world can be ameliorated.
4. Reasonable progress can be made on the problem of population control.
5. The rising tide of crime, drug addiction, and youth anarchy now evident in many Western nations can be controlled before it destroys these societies.

6. Science, engineering, and technology will be pursued across many fronts, from medicine to agricultural and industrial development, to space exploration.

Within this set of assumptions, let me very briefly describe, under seven headings, some of the problems and promises which seem to me to be in store for 1980. Then in the closing section we shall examine the implications for higher education and middle manpower development.

Natural Resources, Ecology, Environment

For the short run, the world's supply of land, water, coal, oil, gas, timber, minerals, and energy are in reasonably good supply, although they are not equally distributed among nations. There are warning flags flying however - - shortages exist in critical metals; reserves of petroleum, natural gas, and coal (fossil fuels) are by no means limitless; stern measures must be taken at once in many regions to insure a continued supply of fresh water; and in many areas of the world we are becoming aware of the fact that fresh air itself is not an ever-present commodity free for the breathing.[1] The assumption that atomic energy can supplant fossil fuels as the world's major energy source is yet to be critically examined. The problems of fission-product waste disposal are just now beginning to be faced, and the solution is not readily evident. If controlled thermonuclear processes can be perfected, much "cleaner" energy transformations will be possible, but there is little certainty that such control will be possible by 1980.

Manpower and money capital, important as they are, are not <u>basic resources</u>. Industrialization, automation, manufacturing, trade, health, even education, are all dependent on ecological and environmental factors. And so, as we note the early warning signs of environmental crisis now, and

realize that by 1980 the warning signs may have turned into roadblocks, it behooves us to plan now for the education and training of persons who can deal effectively with ecological, environmental and natural resources problems.

Population and Urbanization

Various estimates place the increase in the world's population between 1970 and 1980 at figures ranging from 20 percent to 30 percent. Added to the strains which such a population increase would normally bring is the probable fact that nearly all of the population increase will show up in metropolitan areas, unless the trend to urbanization can be halted and reversed. Using the United States as an example, by 1980 over 70 percent of the then population of 241 million is expected to reside in "metropolitan areas" of 50,000 persons or more; and the greatest growth of urban areas is foreseen in those with populations of over 500,000.[2]

The age-structure of the world's population is a matter of great concern also for the 1980's. Advances in gerontology guarantee higher percentages of "oldsters" in the population; and recent world-wide public health programs are resulting in dramatic decreases in infant and child mortality. Consequently the 1980's may see many nations of the world with a bimodal curve of age-structure of the population, with "unproductive" population peaks at both ends of the age spectrum and a relatively smaller segment of the population in the "most productive" (25 to 64 years) age group. The strain on the economy caused by such a bimodal population distribution may be a serious problem by 1980.

Both the age structure and the urban-rural balance of the 1980 population will have significant impact on post-secondary and collegiate education for the 1970's. The "peak" in the youth population will require many

avenues of education and training; and increased urbanization will necessitate new curriculums oriented toward "big city" employment opportunities and "big city" problems.

Transportation, Communication, and Information Technology

For the first time in fifty years a few men are beginning to think the unthinkable thought that maybe the internal combustion engine-powered automobile isn't here to stay after all. Air pollution, traffic problems, accident rates, crime - - all concomitants of the automobile culture - - may combine by 1980 into a compelling social force which will spawn new solutions to transportation problems. Will steam make a comeback? Will new sources of electrons be tapped to make electric autos feasible? Will mass transport systems be perfected? The answers to each of these questions may be known by 1980, and the changes which will occur may cause economic shifts of a magnitude which can hardly be imagined.

Air travel too will be in for some changes. Bigger planes flying faster somehow create about as many problems as they solve. The current solution to these problems is greater airport dispersal, which in simple terms means that when you arrive you are still not there. Supersonic flight is an empty slogan if it takes an hour to claim your luggage and another hour to get downtown. It would seem imperative that for short- to middle-distance runs, surface transportation will make a strong comeback. The kind of fast rail transportation exemplified by Japan's New Tokaido Line may be common in many countries by 1980.

Communications and information exchange. At some near point in time - - perhaps this year or next - - the volume of information exchanged between machines (computers, telemetry equipment, and recorders) will exceed that exchanged between people. New UHF transmitters, microwave channels,

coaxial cables, receiving devices, and antenna designs have "broadened" one-thousand fold the useful radio spectrum over the past thirty years.[3] Solid-state physics has revolutionized the computer as well as radio and television; developments in laser technology promise new breakthroughs in communications, and orbiting satellites will, by 1980, place almost the entire world and all its telephones and television sets in one vast communications network. These prospects for 1980 will call for hundreds of thousands of persons with knowledge and skills now possessed by only a few. It is amazing really, that man in little more than one generation has been able to move from "sound wave and line of sight" communications to Telstar and computer networks. John Pierce puts it well, as he writes:

> "To all these things we adapt, behaviorally and linguistically, in the old mysterious way in which man has always managed to live. We acquire new needs and new standards. A society that functioned well in the absence of telephones, automobiles, and electric power is replaced by a society that would collapse without them."[4]

Health and Medical Science

Between now and 1980 bio-medical engineering will make great progress in the treatment of acute medical and surgical illnesses. The kidney, heart, and lung machines of today are merely the forerunners of a host of hospital hardware for tomorrow. Biochemistry may succeed with mental illnesses where psychology has made only minimal progress; and molecular biology will play an important role in genetics, cancer research and the control of degenerative diseases.

Environmental health will receive a great deal of attention in the next decade, and many societies will face squarely the fact that they just have too many people for their environmental resources to support.

Medical science, aided and abetted by the ingenuity of engineers, physicists, chemists, biologists and technicians, has made great strides in the decade just past. Even greater advances probably lie ahead, but greatly increased numbers and new kinds of health manpower will be required to bring new scientific discoveries to the level of medical practice. According to the U.S. Surgeon General, the United States, for example, will need an additional <u>one million new health workers</u> by 1976.[5] Only about one out of ten of these will be professionals - - the other nine will be technicians and paraprofessionals - - middle manpower.

<u>Science- and Engineering-Based Industry</u>

The industrial sector in advanced nations is heavily capital-intensive (for example, in the U.S. an investment of over $30,000 is required to create one new basic job in heavy industry), and it will no doubt remain so. In underdeveloped countries, on the other hand, industry is and will probably continue to be for the foreseeable future, <u>labor-intensive</u>. Whereas in the U.S., with its high labor costs, men are employed only for those jobs machines cannot do, in labor-intensive economies, machines are purchased only for those jobs which men cannot do.

U.S. industries can expect to encounter tougher and tougher competition in world markets because of high capital and labor costs. The high standard of living of the American worker is the envy of his counterpart in other industrialized nations, but American wage scales have their own built-in booby trap - - they force U.S. industry to eschew labor-intensive

enterprises, and concentrate on complex, scientifically sophisticated, research-connected kinds of end products. And this kind of industry requires a labor force of unusually high levels of education and training. In the United States most semi-skilled and many highly-skilled jobs are done by machines because a man costs too much. An executive of one of the "Big Three" auto manufacturers puts it this way: "These days a person has to have at least a high school education in order to compete with a machine." By 1980 (since machines "get smarter" too), the necessary educational level may well be the associate degree or diploma in technology.

Inputs of science and engineering into all aspects of industry will increase geometrically in the decade ahead. And for the unusual, new, quasi-exotic industries (computers, space, electronics, optics, bioengineering, oceanography, national defense, etc.) manpower development and educational programs will have to feature much greater content from science, mathematics, and engineering than we thought possible during the 1960's. Whereas this year's (1970) need for about 100,000 new industry-related technicians requires that only perhaps ten percent of them be trained in science/engineering-related technologies, the job demands of 1980 may well require that a fourth of all technicians trained in formal educational settings be from technical education programs with a strong science/engineering base. Reflecting the new emphasis on health, ecological stability, environment, and natural resources, much of this new science input will have to be in the biological sciences.

Government and the Service Sector of the Economy

As suggested above, much of the need for government and human services results from urbanization. The problems of living in mass concentrations

of humanity make it necessary that inordinately large numbers of people engage in careers related to public service and human services. Some sort of geometrical relationship exists between the population density of an urban area and the number of workers required to operate its government and public services satisfactorily.

Eight of the most critical urban problems have been identified and listed in a recent issue of the Kiplinger Magazine, Changing Times.[6] They are:

Personnel efficiency

Planning future growth

Eliminating slums

Unsnarling traffic and transportation

Enforcing law and assuring safety

Alleviating social distress

Providing public recreation

Controlling pollution

Although this list applies specifically to American cities, it is suggested that these problems are present in varying degrees of urgency in all big cities of the world.

Many new occupational fields will open up, requiring hundreds of thousands of workers with new kinds of knowledge and skills, in order to revitalize the world's cities by 1980.

The private services sector also will require millions of additional workers during the decade. Jobs which serve the needs of people (for comfort, recreation, entertainment, grooming, housing, food, etc.) are less amenable to automation and mechanization than are production jobs. Consequently, service jobs are not victims of technological advance to the

extent that production jobs are:- - quite the contrary in fact - - as technological advance results in increased affluence and more leisure, the demand for human services rises, and again according to some geometric scale rather than a linear one.

Business and Distribution

Even when production is assured and when a country's gross national product is high, there remain the problems of distribution of goods and services, competition in world markets, sales promotion, management, finance, and investment. The "business world" with its offices, banks, computer centers, stock brokers, wholesalers, retailers, salesmen, secretaries, and clerks is a mass employer of both professional and "middle level" manpower.

One of the "Think" companies in the U.S. is predicting the arrival of the "cashless society" with a gradual disappearance of money and the establishment of direct electronic links from stores and business houses to banks and computer records on each individual's capital balance.[7] Whether such a "far-out" prediction comes true or not, there will most certainly be increased automation of business procedures. However, in my opinion, the "alarmists" who predict that business office jobs will virtually disappear before the onslaught of automation, are wrong. I see nothing in the immediate future at least, which will lessen the need for competent, well-trained office workers. After twenty years of office automation, we all need good secretaries just as much as ever, and I doubt that really competent secretaries will go unemployed in the 1970's. I think it safe to predict that business jobs by 1980 will require people with significantly increased levels of education and training, but that automation will not render business office jobs obsolete.

Having taken a hurried look down the road to 1980, let us now examine the implications of this "vision" for middle manpower development.

III. NEW AND EMERGING OCCUPATIONS IN THE MIDDLE MANPOWER SPECTRUM

In suggesting some new and emerging occupations for the 1970's I will be dealing with the probable changes expected in advanced industrial nations which have a strong scientific-technological base. The applicability of these suggestions to developing nations is, of course, an open question. Some of the "new" occupations will emerge during the coming decade in the Philippines, some may not. Please regard what follows as a "think piece" rather than as a plan.

Five fields of economic endeavor will serve as foci for discussion:

1) Agriculture and natural resources development
2) Business, trade, and distribution
3) Health and human services
4) Industry and manufacturing
5) Science, engineering, and technology

Agriculture and Natural Resources

The total number of jobs in agricultural production in technologically advanced nations will continue to decline,* but new jobs will develop in such fields as agriculture science research, soils analysis, plant pathology, hybridization, hydroponics, harvesting methods, agricultural logistics, and food processing; and in the design, testing, sale, and maintenance of farm equipment and machinery, fertilizers, pesticides and related services.

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*And also in underdeveloped nations, as mechanization, land reform, and scientific methods of farming are gradually introduced.

In underdeveloped countries there will be a rapidly growing need for large numbers of technical or semiprofessional level farm advisors - - persons who will get right out into the rural areas and work with farmers in the padi or the orchard, giving assistance and advice on how to farm more effectively.

In many countries, the increasingly important problems of ecology and natural resources will require training for such emerging occupations as: ecological research technician, forestry aide, wildlife management technician, fisheries adviser, hydrographic technician, marine-culture technician, water resources technician, and desalinization plant technician. All of these jobs will require persons trained in science-based, post-secondary education programs of from one to three (or even four) years. At present these people are in very short supply. Torpey[8] points out that the lack of technicians trained in the marine sciences is the single most critical factor inhibiting the growth of a complex of industries related to the sea.

Business occupations. Here, there may not be a large number of new job titles, but most certainly new knowledge and skills will have to be acquired by many workers to cope with the increasing complexities of the business world. Jobs with names like data-phone operator, computer programmer, data processing technician, and telemetry accountant will become common. Thousands of well-trained technical college graduates in finance, insurance, mathematical statistics, investment, credit, and similar fields will find ready employment. The new paths to decision-making in business opened up by the computer/information retrieval/telemetry networks will require thousands of new "middle management" workers with new competencies, but it remains to be seen whether or not new job titles will be assigned. Secretaries and junior executives will need to be bi- or even tri-lingual as business becomes more international in scope. As inputs to decision-making

become more difficult to control and as their sources become more diffuse, communication across cultural and linguistic barriers is uncertain and geopolitics also becomes a problem.[9] Managers will need better information faster than ever, and this means vastly increased numbers of middle-level workers - - technicians - - to gather data, to retrieve information, to man communications systems, operate computers, prepare graphical analyses, write technical reports, arrange conferences and travel, and yes, type letters and "run the office."

Health and human services. More than thirty allied health technologies have been identified in recent occupational surveys, ranging alphabetically from audiometer operator to X-ray technician. The U.S. Surgeon General noted recently that the ratio of paraprofessionals (technicians) to professionals in the health field in the U.S. was about 6:1, and proclaimed that, in his opinion, this ratio should be increased to 10:1 as rapidly as possible. New and/or emerging occupations include: inhalation therapist, medical illustrator, occupational therapy aide, physical therapy aide, operating room technician, pediatric assistant, unit manager, community health aide, electroencephalograph technician and mental health aide. These and many more allied health occupations will require two or more years of college in science/technology-based curriculums. Again these job titles reflect U.S. needs, but my observations of hospitals and clinics in the great cities of Asia lead me to suggest that similar needs are already being felt here, since standards of health care are rising the world over.

Human service occupations growth is difficult to forecast, in spite of the need for these workers indicated in an earlier section of the paper. There are knotty problems of "image", job status, rate of pay, career security and the like, to be solved in relation to these occupations.

Experience gained in the past decade, however, would indicate that colleges and technical institutes in the United States should plan on providing education and training programs for all or most all of the following occupations by 1980:

Law enforcement officers at all levels

Firemen

Library assistants

Recreation aides

Teacher aides

Social worker aides

Traffic specialists

Urban planning technicians

Community child care center assistants

Environmental health assistants

Public housing managers

Industrial jobs. In all probability there will not be very many, if any, new kinds of jobs at manual skill levels in industry. Industrial workers will still extract, haul, shape, assemble, finish, test, pour, and package manufactured end products using gradually improving machines and devices, powered mostly by electricity. Jobs may necessitate new skills from time to time as methods and materials change, but these are skill increments rather easily acquired on the job or in brief periods of in-plant training. Parenthetically, it is interesting to note that automation to the contrary and certain "alarmists" notwithstanding, three critically short manpower fields in the United States today are not in "new" fields at all, but in the well-known occupations of tool and die technician, auto service mechanic, and building trades craftsman. From my observations of industrial operations,

and from inquiries directed to manufacturers and businessmen here in the Philippines, I find that these three fields are critically short of qualified workers here, also.

Science- and engineering-based technicians. The engineering technologies are not new - - they have been increasing in importance for several decades, and hundreds of technical institutes and junior colleges offer engineering technology programs in the United States. However, the 1970's will bring a host of new jobs at technician levels which will have greater science and engineering content, and many of them will require inputs of knowledge from two or more science disciplines. Examples of some of these new and emerging jobs are listed:

Aerospace technician

Biochemical technician

Bioengineering technician

Bio-medical technician

Computer network technician[10]

Crystallography technician[11]

Earth sciences (geophysics) technician

Environmental control technician

Genetics laboratory technician[12]

Laser technician[13]

Marine sciences technician[14]

Nuclear propulsion technician

Oceanographic technician

Physics research aide

Orbiting satellite systems technician

Solid state physics technician[15]

Wildlife management technician

The list could easily be extended to double this length, but these are enough to illustrate the trend toward multidiscipline, science-oriented technologies. Although these job titles sound highly specialized, it should be pointed out that a common core curriculum is desirable for at least one year out of the two (or three) years of collegiate technical training.

I shall have to leave to you the judgment as to how many of these new job titles may be important in the Philippines in the coming decade.

SUMMARY

Inherent in the predictions of this paper are the following suggestions for educators and curriculum planners:

1. The "new and emerging" occupations will be, for the most part, at semiprofessional and technician levels, rather than at trade and craft levels. Post-secondary education and training will be essential for nearly all the "new" occupations I have described. Some will require two-year programs ("associate degree" level in the U.S.) while others may require three-year diploma programs or four-year bachelor's degree programs.

2. Most of the new middle-manpower occupations will require generous inputs from one or more of the following fields of knowledge: The physical sciences; the biological sciences; the social sciences; the behavioral sciences.

3. More attention will have to be given to increased levels of general education than in occupational training programs in the past. The rationale here is that semiprofessional/technical level jobs:

   a) involve working with or for professionals.

   b) are increasing in breadth and complexity, and tend to be interdisciplinary.

c) generally emphasize cognitive processes more than manipulative processes.

d) will be increasingly involved in "human services."

4. "Clusters" or "families" of occupations can be identified for which a core curriculum approach can be used for the first year at least.

CONCLUSION

Dealing in futures, whether in the commodity market or in the social and behavioral sciences, is an uncertain business. And, of course, my brief sojourn in the Philippines makes any attempt on my part to predict your middle manpower needs presumptuous to say the least. That is why I have purposely placed my discussion within a familiar context - - the probable manpower changes in the U.S. to 1980. In order to predict with accuracy the manpower needs of the Philippines in 1980, we would first need to be able to predict what changes in society the coming decade will bring. Your own futurists are peering away and trying to shade their eyes from the extraneous flashes of light which each day brings. At best they will see the future "through the glass darkly." At worst there will be no image at all. Each of you can look through your own glass and conjure up your own images as I have done. In the Philippines, yours will be much clearer than mine, I am sure.

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